GEOTECHNICAL INVESTIGATION

159-ACRE PROPERTY
ALTA ROAD AND AIRWAY ROAD
SAN DIEGO COUNTY, CALIFORNIA

GEOCON
INCORPORATED
GEOTECHNICAL
CONSULTANTS

PREPARED FOR

WOHL PROPERTY GROUP LLC
SAN DIEGO, CALIFORNIA

FEBRUARY 28, 2005

GEOCON
INCORPORATED

GEOTECHNICAL CONSULTANTS

Project No. 07453-22-01
February 28, 2005

Wohl Property Group LLC
4202 Adams Avenue, Suite B
San Diego, California 92116-2516

Attention: Mr. Emil J. Wohl

Subject: 159-ACRE PROPERTY
ALTA ROAD AND AIRWAY ROAD
SAN DIEGO COUNTY, CALIFORNIA
GEOTECHNICAL INVESTIGATION

Gentlemen:

In accordance with your request and our Proposal No. LG-04568 dated January 4, 2005, we have performed a geotechnical investigation of the subject project in the Otay Mesa area of the County of San Diego, California. The accompanying report presents the results of our study and our conclusions and recommendations regarding the geotechnical aspects of developing the property as proposed.

In our opinion, the site may be developed as planned provided the recommendations of this report are followed.

Should you have any questions regarding this report, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

Raul R. Garcia
RCE 42132

REGISTERED PROFESSIONAL ENGINEER
RAUL R. GARCIA
No. 42132
Exp. 03/06/06
CIVIL
STATE OF CALIFORNIA

Ali Sadr
CEG 1778

PROFESSIONAL GEOLOGIST
ALI SADR
NO. 1778
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Joseph J. Vettel
GE 2401

REGISTERED PROFESSIONAL ENGINEER
JOSEPH J. VETTEL
No. 2401
EXP. 09/30/06
GEOTECHNICAL
STATE OF CALIFORNIA

RRG:AS:JJV:anh

(4) Addressee
(2) Kimley-Horn and Associates, Inc.
Attention: Mr. Michael Knapton

TABLE OF CONTENTS

1. PURPOSE AND SCOPE 1

2. SITE AND PROJECT DESCRIPTION 2

3. SOIL AND GEOLOGIC CONDITIONS 3
   - 3.1 Undocumented Fill Soils (Qudf) 3
   - 3.2 Topsoils (Not Mapped) 3
   - 3.3 Alluvium (Qal) 4
   - 3.4 Terrace Deposits (Qt) 4
   - 3.5 Otay Formation (To) 4
   - 3.6 Geologic Structure 4

4. GROUNDWATER 5

5. GEOLOGIC HAZARDS 5
   - 5.1 Faulting 5
   - 5.2 Soil Liquefaction Potential 6
   - 5.3 Landslides 6

6. CONCLUSIONS AND RECOMMENDATIONS 7
   - 6.1 General 7
   - 6.2 Soil and Excavation Characteristics 8
   - 6.3 Subdrains 8
   - 6.4 Grading 9
   - 6.5 Bulking and Shrinkage 10
   - 6.6 Seismic Design Criteria 11
   - 6.7 Foundations 11
   - 6.8 Concrete Slabs-on-Grade 12
   - 6.9 Retaining Walls and Lateral Loads 13
   - 6.10 Slope Stability 15
   - 6.11 Preliminary Pavement Recommendations 16
   - 6.12 Minimum Resistivity, pH, Water-Soluble Sulfate, and Water-Soluble Chloride 17
   - 6.13 Site Drainage and Moisture Protection 17
   - 6.14 Grading Plan Review 18

LIMITATIONS AND UNIFORMITY OF CONDITIONS

MAPS AND ILLUSTRATIONS

- Figure 1, Vicinity Map
- Figure 2, Geologic Map (Map Pocket)
- Figures 3 – 4, Geologic Cross-Sections A-A′ and B-B′
- Figure 5, Typical Canyon Subdrain Detail
- Figure 6, Typical Subdrain Cutoff Wall Detail
- Figure 7, Typical Subdrain Outlet Headwall Detail
- Figure 8, Wall/Column Footing Dimension Detail
- Figure 9, Retaining Wall Drainage Detail
- Figure 10, Fill Slope Stability Analysis
- Figure 11, Cut Slope Stability Analysis
- Figure 12, Surficial Fill Slope Stability Analysis
- Figure 13, Surficial Cut Slope Stability Analysis

TABLE OF CONTENTS (Continued)

APPENDIX A
FIELD INVESTIGATION
Figures A-1 – A-22, Logs of Trenches

APPENDIX B
LABORATORY TESTING
Table B-I, Summary of Laboratory Direct Shear Test Results
Table B-II, Summary of Laboratory Maximum Dry Density and Optimum Moisture Content Test Results
Table B-III, Summary of Laboratory Expansion Index Test Results
Table B-IV, Summary of Laboratory Minimum Resistivity, Potential of Hydrogen (pH), Water-Soluble Sulfate Test Results
Table B-V, Summary of Laboratory R-Value Test Results

APPENDIX C
RECOMMENDED GRADING SPECIFICATIONS

GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a geotechnical investigation for a 159-acre site located southeast of the intersection of proposed extensions of Alta Road and Airway Road in the Otay Mesa area of San Diego County, California (see *Vicinity Map*, Figure 1). The purpose of the study was to provide information regarding the soil and geologic conditions at the site, as well as any geotechnical constraints that may impact areas of proposed development. This report provides recommendations relative to the geotechnical engineering aspects of developing the property as currently proposed.

The scope of the investigation included performing a review of aerial photographs, topographic maps, previously published geotechnical investigations, and readily available published and unpublished geologic literature pertinent to the property. The scope also included performing a field investigation, laboratory testing to evaluate physical soil properties, engineering analyses, and preparation of this report.

The field investigation was conducted on January 17 and 18, 2005 and consisted of a site reconnaissance and the excavation of 22 exploratory trenches. The approximate locations of the trenches are depicted on the *Geologic Map* (Figure 2). The exploratory trenches were excavated to sample and to observe the general extent and condition of the subsurface geologic units. Details of the field investigation are presented in Appendix A.

Laboratory tests were performed on selected soil samples collected during the field investigation to evaluate pertinent physical properties of the soil types encountered. The laboratory test results were used in engineering analyses and to assist in providing recommendations for site grading and development. Details of the laboratory tests and a summary of the test results are presented in Appendix B.

As part of this study, the following information was reviewed:

1. 1953 stereoscopic aerial photographs of the site and surrounding areas (AXN-3M-24, 25).

2. U.S. Geological Survey, 1968, Otay Mesa *7.5 Minute Quadrangle Map,* photorevised 1975.

3. Kennedy, Michael P. and Siang S. Tan, *Geology Of National City, Imperial Beach and Otay Mesa Quadrangles, Southern San Diego Metropolitan Area, California,* California Division of Mines and Geology, 1977.

4. *Landslide Hazards in the Southern Part of the San Diego Metropolitan Area, San Diego County, California* (Otay Mesa Quadrangle), California Division of Mines and Geology, Open File Report 95-03, 1995.

5. *Topographic Site Plan*, Scale 1 inch equals 200 feet, prepared by Kimley-Horn and Associates Incorporated, undated.

The Geologic Map, Figure 2, depicts the general configuration of the property, existing topography, mapped geologic contacts, and the approximate locations of the exploratory trenches. The base map for Figure 2 consists of a copy of a topographic plan, scale of 1 inch equals 200 feet with contour interval of 2 feet (see Reference No. 5).

The conclusions and recommendations presented herein are based on an analysis of the data obtained from the field investigation, laboratory tests, and experience with similar soil and geologic conditions.

2. SITE AND PROJECT DESCRIPTION

The site encompasses approximately 159 acres of undeveloped land located between the US/Mexico border and proposed extension of Airway Road and east of the proposed extension of Alta Road in the Otay Mesa area of San Diego County, California.

The property is characterized by gently rolling terrain sloping toward the south. Elevations range from 566 feet above Mean Sea Level (MSL) at the northeast corner to 480 MSL at the southeast end of the property.

Presently, the site is vacant. Existing improvements include a water main trending east-west along the north property line, a water aqueduct trending north-south along the west property line, a water pressure reducing station facility located at the southwest corner, a natural gas main trending east-west along the south property line, a concrete pad with a wood structure at the northwest end, and numerous dirt access roads throughout the property. The southeast portion of the property line is bounded by a 150-foot-wide Federal Zone Border Control corridor between the United States and Mexico. The north, east, and west sides are bounded by vacant parcels.

We understand that project development will consist of grading the property to receive sheet-graded industrial lots. We anticipate that Airway Road, Siempre Viva Road, and Via De La Amistad will be extended into the site. The future State Route 11 is proposed crossing the property at the northeast corner. Internal streets are also anticipated as part of project development.

The grading plans were not available for review; however, we anticipate that cuts and fills on the order of 20 feet will likely be designed to achieve subgrade elevations on the proposed sheet-graded lots. We expect that the lots will be fine-graded at a later date on an individual basis. In addition, extensive remedial grading, within the areas to receive fill or structures, in the form of removal and

recompaction of existing fill soils, topsoils, and alluvium is recommended. The buildings will be for industrial and/or commercial usage and will likely consist of concrete tilt-up walls with concrete-reinforced and/or steel structures, supported on conventional continuous and/or spread footings with slab-on-grade floor systems.

The locations and descriptions of the existing and proposed improvements are based on a site reconnaissance, a review of the referenced site plan, and our general understanding of the project as presently proposed. If project details vary significantly from those described, Geocon Incorporated should be retained to update and/or modify this report accordingly.

3. SOIL AND GEOLOGIC CONDITIONS

The field investigation indicated that three surficial soil types: (1) undocumented fill, (2) topsoils, and (3) alluvium and two formational units consisting of Terrace Deposits and Otay Formation underlie the site, and are described below. A Geologic Map and Geologic Cross Sections A-A′ and B-B′ are presented on Figures 2, 3, and 4, respectively.

3.1 Undocumented Fill Soils (Qudf)

Surficial undocumented fill soils in the form of mounds were encountered along the top of the two existing ridges located at the south-central and southeast ends of the site. It is anticipated that these soils were generated during the excavation for the gas main installation and during the grading operations performed for the US/Mexico Border Patrol Corridor. The thickness of these soils ranges from 3 to 6 feet. These soils are characterized as medium soft to stiff, damp to moist, dark brown to grayish brown, sandy clay with gravel and clayey sand. Existing undocumented fill soils are unsuitable in their present condition to receive additional structural fill, and should be removed and compacted as indicated in the *Grading* section of this report. The undocumented fill soils located in the central-south ridge are within an environmentally sensitive area where vernal pools have developed. It is our understanding that this area will not be developed.

3.2 Topsoils (Not Mapped)

Topsoils, 1½ to 4½ feet thick, mantle the entire property. These soils are characterized as soft to medium, stiff, damp to very moist, dark gray to dark grayish brown, slightly sandy clays with gravel. These soils exhibit variable density and moisture content and are unsuitable to receive additional structural fill soils or settlement-sensitive structures. Therefore, remedial grading measures in the form of removal and compaction, as indicated herein, are required. The topsoils exhibit "medium" to "high" expansion characteristics and should be placed in deep portions of the fills.

3.3 Alluvium (Qal)

Alluvial soils were encountered in the bottom of the north-south trending drainage channel located at the east end of the site and range in thickness from 9 to 10 feet. The alluvial soils are characterized as soft to stiff, very moist, dark gray brown, silty, sandy clays with gravel and cobble. The alluvium is not considered suitable to support structural fill or settlement-sensitive structures and will require remedial grading in the form of complete removal in areas receiving improvements. The soil excavated from this unit is suitable for use as structural fill.

3.4 Terrace Deposits (Qt)

Quaternary-age Terrace Deposits were encountered underlying the topsoil in the southern-half of the site. This unit typically consists of two fairly distinct members. The upper, silty, sandy clay layer overlies the lower, coarse-grained, granular layer. The upper layer consists of 1 to 8 feet of very stiff to hard, moist, brown, sandy clay. The upper clayey soil member was encountered in exploratory trenches 20, 21, and 22. The lower layer consists of dense to very dense, moist, tan to brown, silty and clayey sand with varying amounts of gravel. Some of the sandy soil layers are partially cemented, while other lenses are cohesionless. The Terrace Deposits possess adequate strength characteristics for support of structures and/or vehicular loads; however, the upper layer possesses a "high" expansion potential and poor pavement support characteristics. Special grading recommendations are provided herein.

3.5 Otay Formation (To)

The northern half of the site is underlain by the Tertiary-age Otay Formation and extend to the maximum depth of exploration. The Otay Formation primarily consists of dense, damp to moist, light gray, silty, fine to medium, slightly cemented sandstone and fine sandy siltstone with lenses of silty and sandy claystone. Localized portions of the near-surface Otay Formation may exhibit moderate to high weathering and bioturbation and is not suitable in its natural state for the support of structural loads and should be removed during grading to dense, unweathered Otay Formation. In general, the soils of the Otay Formation exhibit low to medium expansion potential and should generally provide adequate bearing support characteristics in its natural state. Soils excavated from the weathered and unweathered Otay Formation are suitable for use as structural fill.

3.6 Geologic Structure

Based on observations performed during our field exploration and experience with adjacent sites, the Terrace Deposits have near horizontal bedding with no discernable dip evident within the units.

4. GROUNDWATER

No groundwater seepage was observed in any of the exploratory trenches except for Trench T-5. A localized perched groundwater condition was encountered at a depth of 15½ feet in exploratory Trench T-5. Perched groundwater conditions should be expected to occur seasonally and may affect site grading if grading operations are performed during or shortly after the rainy season. In addition, perched groundwater levels should be expected at the bottom of the existing drainage channels. Groundwater is not expected to be a hazard to the site; however, if grading operations are performed during the rainy season, saturated conditions and extensive moisture conditioning operations should be expected. Proper surface drainage of irrigation water and precipitation will be critical to future performance of the project.

5. GEOLOGIC HAZARDS

5.1 Faulting

A review of the previously referenced geologic literature indicates that there are no known active or potentially active faults at the site or in the immediate vicinity.

The Rose Canyon Fault, located approximately 13.5 miles northwest of the site, is the closest active fault. An active fault is defined by the California Geological Survey (CGS) as a fault with evidence for Holocene activity (approximately 11,000 years before present).

Earthquakes that might occur on the Rose Canyon Fault Zone, the Coronado Bank Fault, Elsinore Fault, and other faults within the southern California/northern Baja California area are potential generators of significant ground motion at the site. To find the distance of known faults from the site, the computer program *EQFAULT* (Blake 1989, revised 2004), was utilized. The results of the deterministic analysis indicate that the Rose Canyon Fault Zone is the predominant source for potential ground motion at the site due to its proximity to the site. The Rose Canyon Fault is postulated as having the potential to generate a maximum earthquake of magnitude 7.2.

Presented on the following table are the earthquake events, the distance from the fault to the site, and calculated peak site accelerations for the faults considered most likely to subject the site to ground shaking.

TABLE 5.1
DETERMINISTIC SITE PARAMETERS FOR SELECTED ACTIVE FAULTS

Fault Name	Distance From Site (miles)	Estimated Maximum Magnitude	Estimated Peak Site Acceleration (g)
Rose Canyon Fault Zone	13.5	7.2	0.21
Coronado Bank	20.1	7.6	0.19
Elsinore-Julian	41.8	7.1	0.06
Elsinore-Coyote Mountain	42.8	6.8	0.05
Earthquake Valley	45.4	6.5	0.04
Newport-Inglewood-Offshore	51.1	7.1	0.05
Elsinore-Temecula	56.9	6.8	0.03

The site could be subjected to moderate to severe ground shaking in the event of an earthquake on any of the above tabulated faults or other faults in the southern California and northern Baja California area. However, the seismic risk is not considered significantly different from that of the surrounding developments. While listing of peak accelerations is useful for comparison of potential effects of fault activity in a region, other considerations are important in seismic design, including the frequency and duration of motion and the soil conditions underlying the site. We recommend that seismic design of buildings and associated improvements be performed in accordance with the Uniform Building Code (UBC) currently adopted by the County of San Diego.

5.2 Soil Liquefaction Potential

Soil liquefaction occurs within relatively loose, cohesionless sands located below the water table that are subjected to ground accelerations from earthquakes. Due to the relatively high in-situ density of the underlying soils and the lack of permanent near-surface groundwater, the potential for liquefaction occurring at the site is considered very low.

5.3 Landslides

No landslides were encountered during the site investigation and none are known to exist on the property or at a location that would impact the proposed development.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 General

6.1.1 No soil or geologic conditions were encountered that would preclude the development of the property as proposed, provided the recommendations of this report are followed.

6.1.2 The field investigation indicates that the site is underlain by compressible undocumented fill soils, topsoils, and alluvium. The Otay Formation underlies the topsoils in the northern portion of the site and extends to the maximum depth of exploration. Terrace Deposits underlie the topsoils in the southern portion.

6.1.3 The undocumented fill, topsoil, alluvium, and the weathered, upper sections of the Otay Formation, are not considered suitable for the support of fill or structural loads in their present condition and will require remedial grading. Removal depths for topsoils between approximately 1½ and 4½ feet should be expected during grading operations. Removal depths of alluvium between 3 and 10 feet should be expected during grading operations. The actual depth of removal should be evaluated during grading operations.

6.1.4 Highly expansive soils will be encountered within the topsoil, alluvium, and the clayey member of the Terrace Deposits. Topsoil and alluvium will be removed during remedial grading operations. Where highly expansive Terrace Deposits are exposed at finish grade, they should be undercut to provide at least a 5-foot-thick cap of "low" to "medium" expansive soil. Highly expansive soils should be placed in deeper portions of the fill areas. There are sufficient low- to medium-expansive soils available for capping purposes on site to mitigate expansive soils.

6.1.5 The sandy soils of the Terrace Deposits and the soils of the Otay Formation should provide adequate soil support characteristics in their natural state and where placed as properly compacted fill.

6.1.6 Fill areas or areas stripped of native vegetation will require special consideration to reduce the erosion potential. In this regard, desilting basins, improved surface drainage and early planting of erosion-resistant ground covers are recommended.

6.1.7 Subsurface conditions observed may be extrapolated to reflect general soil and geologic conditions; however, variations in subsurface conditions between trench locations should be anticipated.

6.1.8 No significant geologic hazard that would adversely affect the proposed project, other than seismic shaking and expansive soils, were observed or are known to exist on the site.

6.2 Soil and Excavation Characteristics

6.2.1 The topsoils, alluvium, and the clayey member of the Terrace Deposits possess "high" expansion potential. The sandy member of the Terrace Deposits and Otay Formation exhibit low- to medium-expansive potential. The expansion characteristics of the in-situ soils were determined in accordance with the Uniform Building Code (UBC) Table No. 18-I-B.

6.2.2 We expect that the majority of on-site materials can be excavated with moderate to heavy effort using conventional heavy-duty grading equipment.

6.2.3 Excavation and compaction difficulties may be experienced if grading operations are performed when the clayey soils are very wet or very dry. Extensive moisture conditioning may be required in either case.

6.3 Subdrains

6.3.1 The geologic units encountered on the site exhibit permeability characteristics that could be susceptible under certain conditions to groundwater seepage and perching. The construction of a canyon subdrain is recommended to mitigate the potential for adverse impacts associated with hydrocompaction and seepage conditions. Figure 2 depicts the recommended subdrain location. Figure 5 depicts a typical canyon subdrain detail.

6.3.2 The final segment (low end) of the subdrain should consist of non-perforated drainpipe. At the non-perforated/perforated interface, a seepage cutoff wall should be constructed in accordance with Figure 6. If the subdrain should discharge into an existing open drainage channel a permanent head wall structure should be constructed in accordance with Figure 7.

6.3.3 The final grading plans should indicate the location of the proposed subdrain. Upon completion of the subdrain installation, the project civil engineer should survey the subdrain locations prior to fill placement and provide an as-built grading plan depicting the subdrain locations.

6.4 Grading

6.4.1 All grading should be performed in accordance with the *Recommended Grading Specifications* contained in Appendix C and the County of San Diego Grading Ordinances. Where the recommendations of Appendix C conflict with this report, the recommendations of this report should take precedence.

6.4.2 Earthwork should be observed by and compacted fill tested by representatives of Geocon Incorporated.

6.4.3 Prior to commencing grading, a preconstruction conference should be held at the site with the owner or developer, grading contractor, civil engineer, and geotechnical engineer in attendance. Special soil handling and the grading plans can be discussed at that time.

6.4.4 Site preparation should begin with the removal of all deleterious material and vegetation. The depth of removal should be such that material exposed in cut areas or soil to be used as fill is relatively free of organic matter. Deleterious material generated during stripping should be exported from the site.

6.4.5 All potentially compressible surficial soils (undocumented fill soil, topsoil, alluvium, and weathered Otay Formation) within areas of planned grading should be removed to firm, unweathered dense soil of the Otay Formation and/or dense soils of the Terrace Deposits prior to placing fill and/or proposed settlement-sensitive improvements. The actual extent of the remedial grading should be determined in the field by the project geotechnical engineer or engineering geologist. Overly wet soil will require drying or mixing with drier soils to facilitate proper compaction.

6.4.6 Once the removal of unsuitable soil is complete, the exposed ground surface should be scarified to a depth of approximately 12 inches, moisture conditioned to 1 to 3 percent above optimum moisture content, and compacted to a minimum relative compaction of 90 percent as determined by ASTM D 1557-02.

6.4.7 Soil generated from on-site excavations are suitable for re-use as fill provided it is free from vegetation, debris and other deleterious material. Fill should be placed in layers no thicker than approximately 8 inches to allow for adequate bonding and compaction. All fill and backfill should be compacted to at least 90 percent of the maximum dry density at a moisture content ranging from 1 to 3 percent above optimum, as determined in accordance with ASTM Test Procedure D 1557-02. Fill soils placed at moisture contents outside this

range of moisture content may be considered unacceptable at the discretion of the geotechnical engineer.

6.4.8 In order to reduce the potential for differential settlement, it is recommended that where permanent buildings are planned, the cut portion of cut-fill transition pads within the building envelope be undercut 3 feet below finish-pad grade and replaced with properly compacted, low- to medium- expansive fill soils. The undercut should extend 5 feet laterally beyond the building footprint. Undercutting may also be necessary if concretions or cemented zones are exposed at or near finish grade. Similarly, cut lots containing highly expansive soils within 5 feet of finish grade should be undercut 5 feet and capped with low to medium expansive compacted fill.

6.4.9 The upper 5 feet of all building pads (cut or fill) and 2 feet in pavement areas should be composed of properly compacted or undisturbed formational *low* to *medium* expansive soils. Fill soils with a high expansion potential should be placed in the deeper fill areas and properly compacted. *Low* to *medium* expansive soils are defined as those soils that have an Expansion Index of 90 or less when tested in accordance with UBC Table 18-I-B. Rocks greater than 12 inches in maximum dimension should not be placed in accordance with Section 6 of Appendix C.

6.4.10 Bentonitic soil, if encountered, may have a very high expansive potential (EI greater than 130) and should not be placed within 10 feet of finish grade.

6.4.11 Lots where bentonitic soils are present within 10 feet of finish grade should be individually evaluated and mitigative measures provided in updated geotechnical reports once building location and anticipated structural loads are determined.

6.5 Bulking and Shrinkage

6.5.1 Estimates of embankment bulking and shrinkage factors are typically based on comparing laboratory compaction tests with the density of the soil in its natural state. Variations in existing soil density, as well as in compacted fill densities, render shrinkage value estimates very approximate. As an example, the contractor can compact the fill soils to any relative compaction of 90 percent or higher of the maximum laboratory density. Thus, the contractor has approximately a 10 percent range of control over the fill volume. Based on our experience on nearby sites, in our opinion the following shrinkage/bulk factors can be used as a basis for estimating how much the on-site soils may shrink or swell (bulk) when excavated from their existing state and placed as compacted fills.

TABLE 6.5
SHRINKAGE AND BULK FACTORS

Soil Unit	Shrink/Bulk Factor
Undocumented Fill Soil	15 to 20 percent shrinkage
Topsoil, alluvium, and weathered Otay Formation	10 to 15 percent shrinkage
Terrace Deposits and Otay Formation	5 to 10 percent bulk

6.6 Seismic Design Criteria

6.6.1 For seismic design, the following table summarizes site-specific design criteria per the 2000 CBC. The values listed on Table 6.6 are for Type B faults.

TABLE 6.6
SEISMIC DESIGN PARAMETERS

Parameter	Value	CBC Reference
Seismic Zone Factor	0.40	Table 16-I
Soil Profile Type	S_C	Table 16-J
Seismic Coefficient, C_a	0.40	Table 16-Q
Seismic Coefficient, C_v	0.56	Table 16-R
Near-Source Factor, N_a	1.0	Table 16-S
Near Source Factor, N_v	1.0	Table 16-T
Seismic Source	B	Table 16-U

6.7 Foundations

6.7.1 The following recommendations are for one- or two-story structures and assume that the grading operations will be performed as indicated in this report. The project is suitable for the use of continuous strip footings, isolated spread footings, or appropriate combinations thereof. In general, continuous footings for one- and/or two-story structures should be at least 12 inches wide and should extend at least 18 inches below lowest adjacent pad grade into properly compacted fill soils. Isolated spread footings should be at least 2 feet wide and extend at least 18 inches below lowest adjacent grade. If differential fill thickness beneath a proposed building exceeds 20 feet, modifications may be required. Figure 8 presents a construction detail depicting the depth to lowest adjacent grade. Minimum continuous footing reinforcement for one- and/or two-story structures should consist of four No. 4 steel reinforcing bars placed horizontally in the footings, two near the top and

two near the bottom. Recommendations for reinforcement of isolated spread footings should be provided by the project structural engineer.

6.7.2 The recommended dimensions and steel reinforcement presented above are based on soil characteristics only and are not intended to be in lieu of reinforcement necessary to satisfy structural loading. Actual reinforcement of the foundations should be designed by the project structural engineer.

6.7.3 The recommended allowable bearing capacity for foundations designed as recommended above is 2,500 pounds per square foot for 18-inch-deep footings. The values presented above are for dead plus live loads and may be increased by one-third when considering transient loads due to wind or seismic forces.

6.7.4 Foundation excavations should be observed by the geotechnical engineer (a representative of Geocon Incorporated) prior to the placement of reinforcing steel and concrete to verify that the exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.

6.7.5 Footings located within 7 feet of the top of slopes are not recommended. However, footings that must be located within this zone should be extended in depth such that the outer bottom edge of the footing is at least 7 feet horizontally inside the face of the slope.

6.8 Concrete Slabs-on-Grade

6.8.1 Interior concrete slabs-on-grade for office usage should be at least 5 inches thick and should be underlain by at least 4 inches of clean sand. Where moisture-sensitive floor coverings are planned, a visqueen moisture barrier should be provided and placed at the mid-point within the 4-inch sand cushion. For warehouse floors and/or where heavy concentrated floor loads or light to medium forklift loads are anticipated, the slab thickness should be increased to 6 inches and underlain by 4 inches of Class 2 base rock material compacted to 95 percent relative compaction. If heavy forklift loads are anticipated, the slab thickness should be increased to 7 inches and should be underlain by at least 6 inches of Class 2 base rock material. The allowable soil bearing pressure under slabs with low to medium expansive soils is 1,500 pounds per square foot.

6.8.2 Minimum reinforcement of slabs-on-grade placed on low- to medium-expansive soil should consist of No. 3 reinforcing bars placed at 18 inches on center in both horizontal directions. The concrete slabs-on-grade should also be provided with dowels extended from

the slabs to footings and walls to prevent vertical movement between the slabs and footings and/or walls.

6.8.3 The concrete slab-on-grade recommendations are minimums based on soil support characteristics only. We recommend that the project structural engineer evaluate the structural requirements of the concrete slabs for supporting equipment and storage loads.

6.8.4 All exterior concrete flatwork not subject to vehicular traffic should conform to the following recommendations. Slab panels in excess of 8 feet square should be at least 4 inches thick and should be reinforced with 6x6-W2.9/W2.9 (6x6-6/6) welded wire mesh to reduce the potential for cracking. In addition, all concrete flatwork should be provided with crack-control joints to reduce and/or control shrinkage cracking. Crack-control spacing should be determined by the project structural engineer based upon the slab thickness and intended usage. Criteria of the American Concrete Institute (ACI) should be taken into consideration when establishing crack-control spacing. Subgrade soils for exterior slabs should be compacted in accordance with criteria presented in the grading section of this report. The subgrade soils should not be allowed to dry prior to placing concrete.

6.8.5 The recommendations presented herein are intended to reduce the potential for cracking of slabs and foundations as a result of differential movement due to medium-expansive soils. However, even with the incorporation of these recommendations, foundations and slabs-on-grade will still exhibit some cracking. The occurrence of concrete shrinkage cracks is independent of the soil supporting characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, the use of crack control joints, and proper concrete placement and curing. Crack-control joints should be spaced at intervals no greater than 12 feet. Literature provided by the Portland Cement Association (PCA) and American Concrete Institute (ACI) present recommendations for proper concrete mix, construction and curing practices, and should be incorporated into project construction.

6.9 Retaining Walls and Lateral Loads

6.9.1 Retaining walls that are allowed to rotate more than 0.001H (where H equals the height of the retaining position of the wall) and having a level backfill surface should be designed for an active soil pressure equivalent to the pressure exerted by a fluid with a density of 30 pounds per cubic foot (pcf). Where the backfill will be inclined at no steeper than 2:1 (horizontal:vertical), an active soil pressure of 50 pcf is recommended. These soil pressures assume that the backfill materials within an area bounded by the wall and a 1:1 plane extending upward from the base of the wall possess an Expansion Index of less than 50.

Where backfill materials do not conform to the above criteria, Geocon Incorporated should be consulted for additional recommendations.

6.9.2 Where walls are restrained from movement at the top, an additional uniform pressure of 7H psf (where H equals the height of the retaining wall portion of the wall in feet) should be added to the active soil pressure presented above. For retaining walls subject to vehicular loads within a horizontal distance equal to two-thirds of the wall height, a surcharge equivalent to 2 feet of fill soil (240 psf) should be added to the loading diagram.

6.9.3 All retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces and should be waterproofed as required by the project architect. The use of drainage openings through the base of the wall (weep holes, etc.) is not recommended where the seepage could be a nuisance or otherwise adversely impact the property adjacent to the base of the wall. The above recommendations assume a properly compacted granular (Expansion Index less than 50) backfill material with no hydrostatic forces or imposed surcharge load. If conditions different than those described are anticipated, Geocon Incorporated should be contacted for additional recommendations. A typical retaining wall drainage detail is provided on Figure 9.

6.9.4 In general, wall foundations having a minimum depth and width of 1 foot may be designed for an allowable soil bearing pressure of 2,000 psf, provided the soil within 3 feet below the base of the wall has an Expansion Index of less than 90. The proximity of the foundation to the top of a slope steeper than 3:1 could impact the allowable soil bearing pressure. Therefore, Geocon Incorporated should be consulted where such a condition is anticipated.

6.9.5 For resistance to lateral loads, an allowable passive earth pressure equivalent to a fluid with a density of 300 pcf is recommended for footings or shear keys poured neat against properly compacted granular fill soils or undisturbed natural soils. The allowable passive pressure assumes a horizontal surface extending at least 5 feet or three times the surface generating the passive pressure, whichever is greater. The upper 12 inches of material not protected by floor slabs or pavement should not be included in the design for lateral resistance. An allowable friction coefficient of 0.35 may be used for resistance to sliding between soil and concrete. This friction coefficient may be combined with the allowable passive earth pressure when determining resistance to lateral loads.

6.10 Slope Stability

6.10.1 Slope stability analyses using laboratory shear strength information and experience with similar soil conditions in nearby areas indicate that 2:1 (horizontal:vertical) fill slopes constructed of on-site granular materials should have calculated factors of safety of at least 1.5 under static conditions for both deep-seated failure and shallow sloughing conditions for heights of 20 feet. Figure 10 presents slope stability calculations. The 2:1 cut slopes are expected to be excavated predominantly in the Otay Formation. Based on the calculations presented on Figure 11 and experience with similar conditions, 2:1 cut slopes to the planned heights should possess a factor of safety of at least 1.5 with respect to slope instability if free of adversely oriented bedding, joints or fractures. Slope stability calculations for surficial stability conditions are presented on Figures 12 and 13.

6.10.2 Keying and benching operations during grading of the slopes should be performed in accordance with Appendix C. Due to the presence of highly weathered Otay Formation at some locations, keying operations may extend deeper than normal (on the order of 3 to 5 feet).

6.10.3 Cut slopes within the Otay Formation may require further evaluation due to the possible presence of claystone lenses. A stability fill may be necessary to prevent surficial sloughage of the slope face. The potential presence of bentonitic clay lenses and the associated slope stability recommendations can be addressed at the time of grading.

6.10.4 All cut slope excavations should be observed during grading operations by the project engineering geologist to verify that soil and geologic conditions do not differ significantly from those anticipated.

6.10.5 The outer 15 feet (or a distance equal to the height of the slope, whichever is less) of fill slopes should be composed of properly compacted granular *soil* fill to reduce the potential for surficial sloughing. In general, soils with an Expansion Index of less than 90 or at least 35 percent sand size particles should be acceptable as *granular* fill. Slopes should be compacted by backrolling with a loaded sheepsfoot roller at vertical intervals not to exceed 4 feet and should be track-walked at the completion of each slope such that the fill soils are uniformly compacted to at least 90 percent relative compaction to the face of the finished slope.

6.10.6 All slopes should be landscaped with drought-tolerant vegetation having variable root depths and requiring minimal landscape irrigation. In addition, all slopes should be drained

and properly maintained to reduce erosion. Slope planting should generally consist of drought-tolerant plants having a variable root depth. Slope watering should be kept to a minimum to just support the plant growth.

6.11 Preliminary Pavement Recommendations

6.11.1 The following recommendations are for preliminary purposes and are provided for interior streets, light vehicle traffic, and parking areas. The final pavement section design will depend upon soil conditions exposed at subgrade elevation, the results of additional Resistance Value (R-Value) following grading, and the criteria observed by the County of San Diego Public Works Department. The Traffic Indices are estimates and will require evaluation of traffic loads by the project civil engineer. The following preliminary flexible pavement section recommendations are for on-site low to medium expansive soils.

TABLE 6.11
PRELIMINARY PAVEMENT RECOMMENDATIONS
(R-VALUE = 26)

Location	Traffic Index	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
Heavy Truck Traffic	7.0	4.0	10.5
Interior Light Vehicle Traffic	5.5	3.0	8.0
Parking Stalls	4.5	3.0	4.0

6.11.2 Pavement subgrade soils should be scarified, moisture conditioned, and recompacted to a minimum of 95 percent relative compaction as determined by ASTM D 1557-02. The depth of compaction should be at least 12 inches. Class 2 base course material should be moisture conditioned to near optimum moisture content and compacted to a minimum of 95 percent relative compaction as determined by ASTM D 1557-02.

6.11.3 Class 2 base should conform to Section 26-1.02B of the *Standard Specifications for the State of California Department of Transportation (Caltrans).* The asphalt concrete should conform to Section 203-6 of the *Standard Specifications for Public Works Construction (Greenbook).*

6.11.4 The performance of asphalt concrete pavement is highly dependent upon providing positive surface drainage away from the edge of the pavement. Ponding of water on or adjacent to the pavement may result in pavement distress and subgrade failure. In addition, the surface

drainage within planters should be such that ponding will not occur. Perimeter curbs adjacent to landscaped areas should extend to at least 12 inches below subgrade elevation to act as a cut off to moisture migration.

6.12 Minimum Resistivity, pH, Water-Soluble Sulfate, and Water-Soluble Chloride

6.12.1 Laboratory test results indicate very low sulfate content with negligible sulfate exposure ratings according to California Building Code Table No. 19-A-4. Tests results are presented on Table B-IV. Minimum resistivity test results indicates a severe corrosion potential with respect to buried metals. These tests were performed on samples selected at random and may not be representative of the actual corrosive potential of all the soils that will be exposed during the phases of grading and construction.

6.12.2 Geocon Incorporated does not practice in the field of corrosion engineering. Therefore, if corrosion-sensitive improvements are planned, we recommend further evaluation by a corrosion engineer be performed to incorporate the necessary precautions to avoid premature corrosion to concrete or buried metal underground lines in direct contact with in-situ soils.

6.13 Site Drainage and Moisture Protection

6.13.1 Adequate drainage is critical to reduce the potential for differential soil movement, erosion, and subsurface seepage. Under no circumstances should water be allowed to pond adjacent to footings. The site should be graded and maintained such that surface drainage is directed away from structures and the top of slopes into swales or other controlled drainage devices. Roof and pavement drainage should be directed into conduits that carry runoff away from the proposed structure.

6.13.2 Landscaping planters adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate into the pavement's subgrade and base course. We recommend that subdrains to collect excess irrigation water and transmit it to drainage structures or impervious above-grade planter boxes be used. In addition, where landscaping is planned adjacent to the pavement, a cutoff wall along the edge of the pavement that extends at least 12 inches below the subgrade should be constructed.

6.14 Grading Plan Review

6.14.1 The geotechnical engineer or engineering geologist should review the Grading Plans prior to finalization to verify their compliance with the recommendations of this report and determine the need for additional investigation, comments, recommendations, and/or analysis.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

2. This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

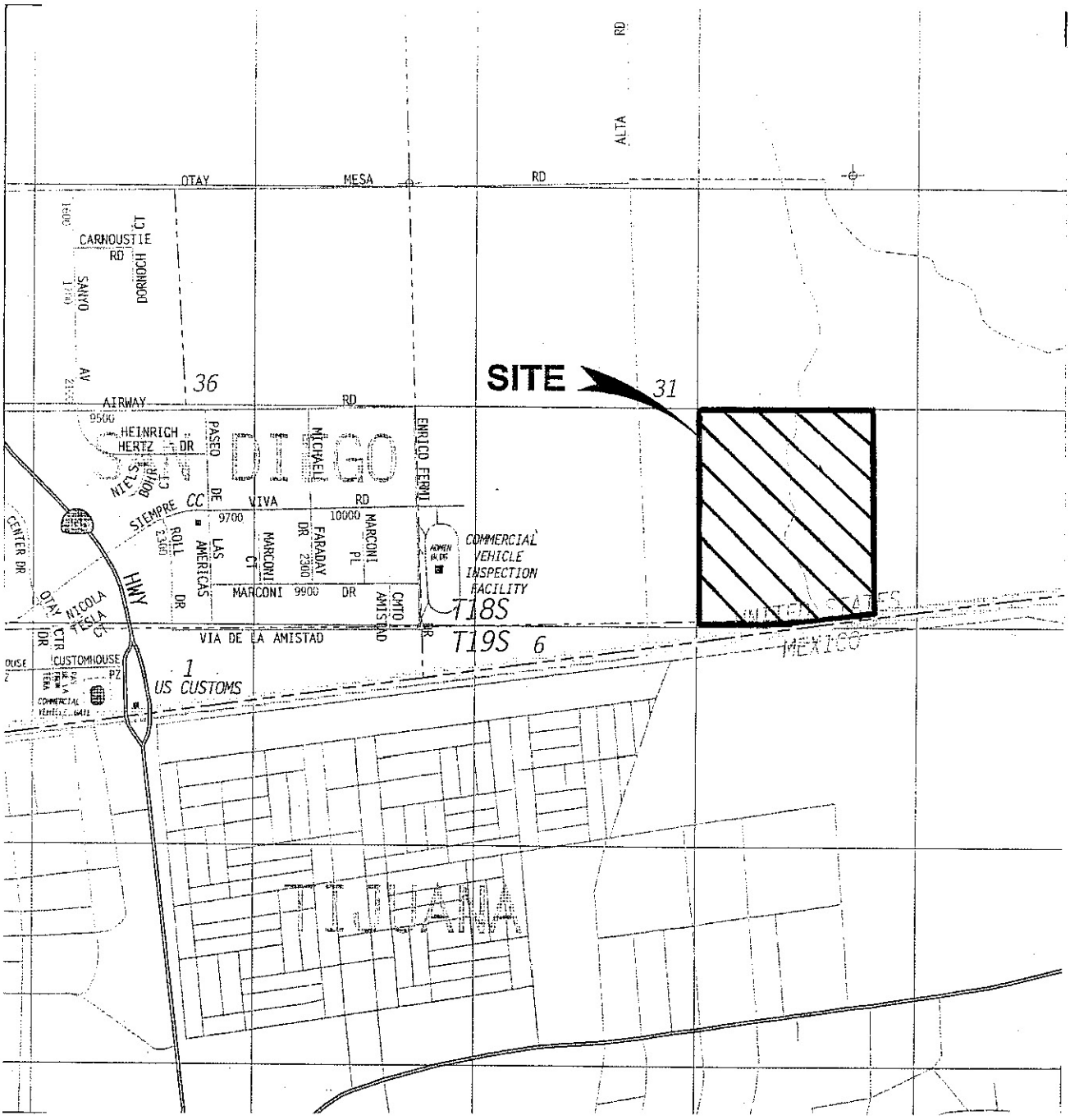
3. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

2. This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.



SOURCE: 2005 THOMAS BROTHERS MAP
SAN DIEGO COUNTY, CALIFORNIA

N
NO SCALE

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

RG/RA		DSK/E0000

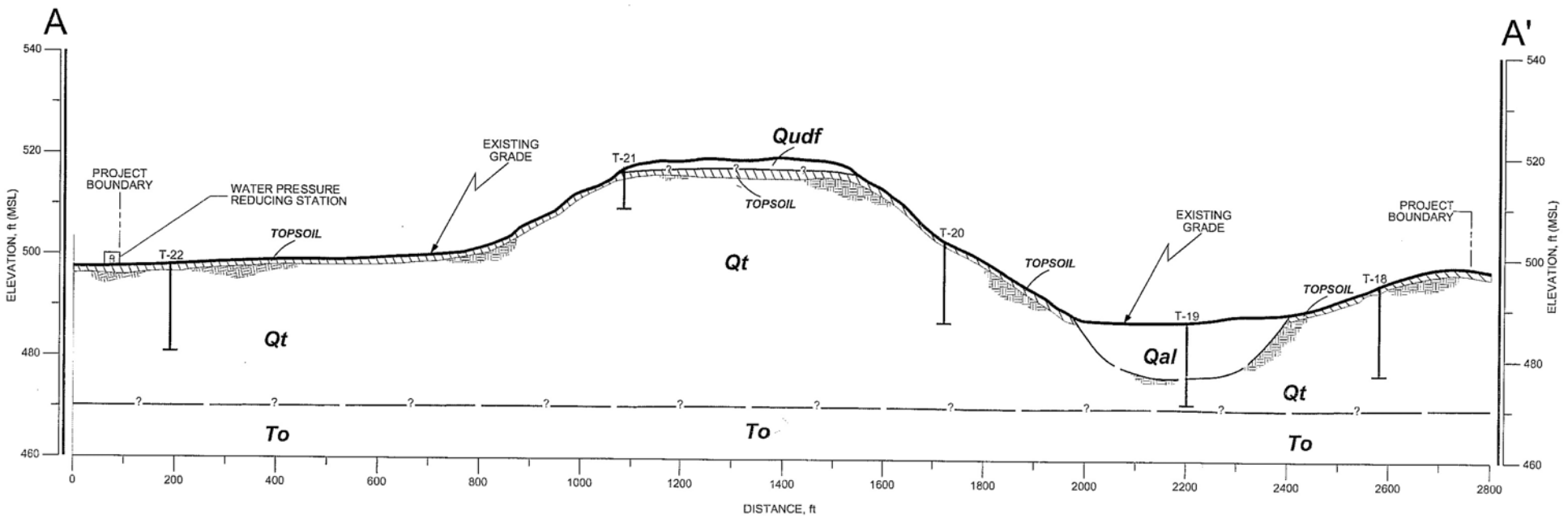
C:/Documents and Settings/Drafting 2/Ruben/Templates/Templates/Geotech/Site Plan

VICINITY MAP

159 ACRE SITE
SAN DIEGO COUNTY, CALIFORNIA

DATE 02-28-2005	PROJECT NO. 07453 - 22 - 01	FIG. 1

159 ACRE SITE
SAN DIEGO, CALIFORNIA



GEOLOGIC CROSS SECTION A - A'

SCALE: 1" = 200' (HORIZ.)
1" = 20' (VERT.)

GEOCON LEGEND

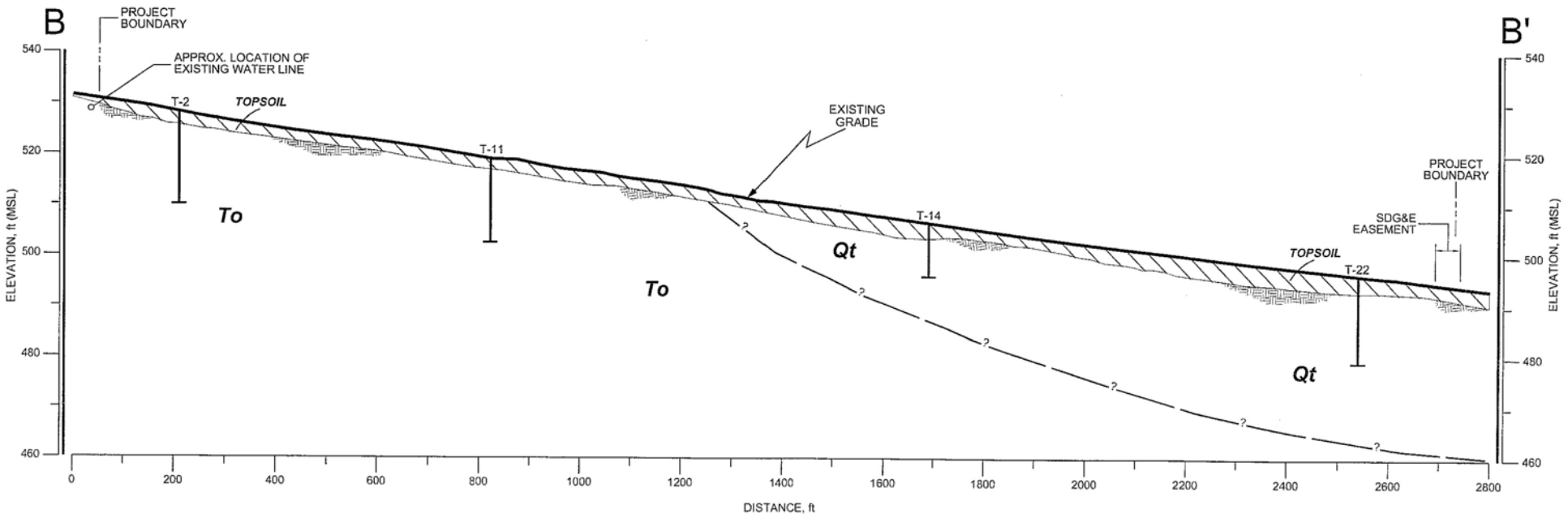
- ***Qal*** .....ALLUVIUM
- ***Qt*** .....TERRACE DEPOSITS
- ***To*** .....OTAY FORMATION
- ~?~ .....APPROX. LOCATION OF GEOLOGIC CONTACT (Queried Where Uncertain)

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

PROJECT NO. 07453 - 22 - 01
FIGURE 3
DATE 02-28-2005

X:\R&TEMP\T_GEOTECH_RUBEN\G_7453 X-SECTNS\DWG

159 ACRE SITE
SAN DIEGO, CALIFORNIA



GEOLOGIC CROSS SECTION B - B'

SCALE: 1" = 200' (HORIZ.)
1" = 20' (VERT.)

GEOCON LEGEND

Qt .....TERRACE DEPOSITS

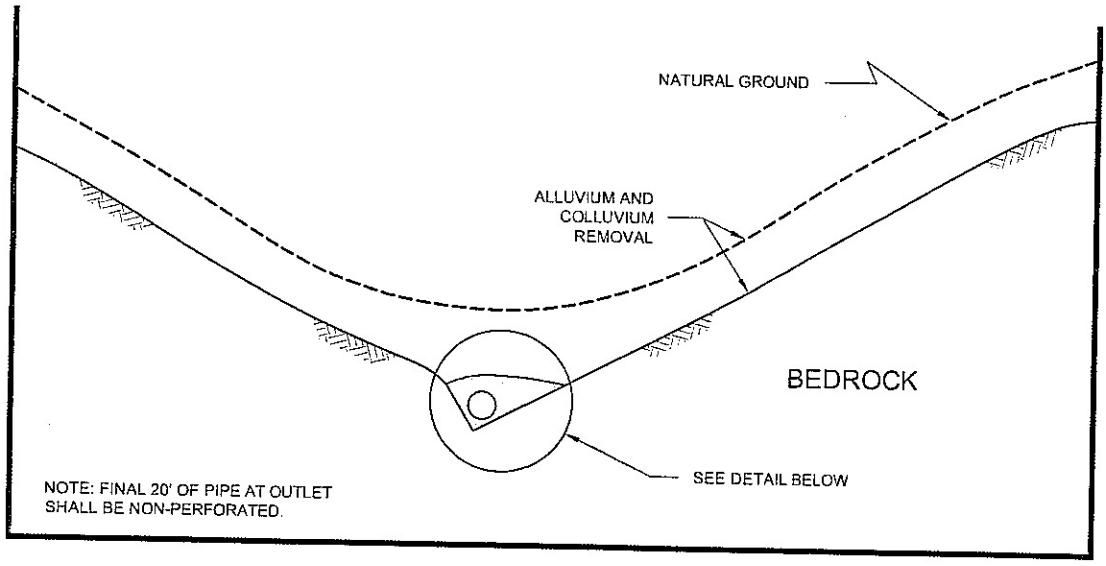
To .....OTAY FORMATION

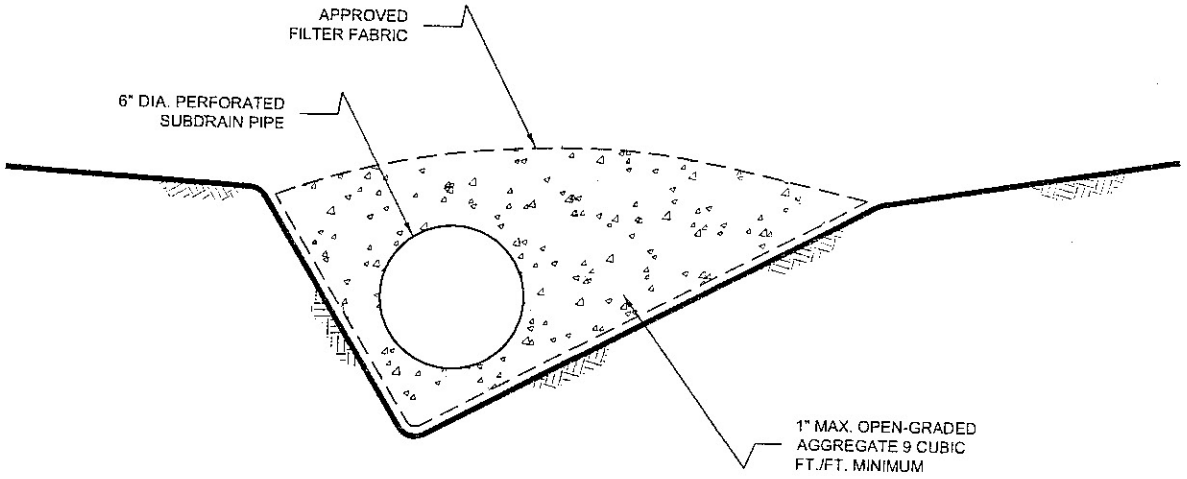
~?~.....APPROX. LOCATION OF GEOLOGIC CONTACT
(Queried Where Uncertain)

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

PROJECT NO. 07453 - 22 - 01
FIGURE 4
DATE 02-28-2005

X:\R14TEMP\T_GEOTECH_RUBEN\G_7453 X-SECTNS\DWG





NOTE:

1.....SUBDRAIN PIPE SHOULD BE 6-INCH MINIMUM DIAMETER, PERFORATED, THICK WALLED SCHEDULE 40 PVC, SLOPED TO DRAIN AT 1 PERCENT MINIMUM AND CONNECTED TO STORM DRAIN SYSTEM OR APPROVED OUTLET.

2.....FILTER FABRIC TO BE MIRAFI 140N OR EQUIVALENT.

NO SCALE

TYPICAL CANYON SUBDRAIN DETAIL

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

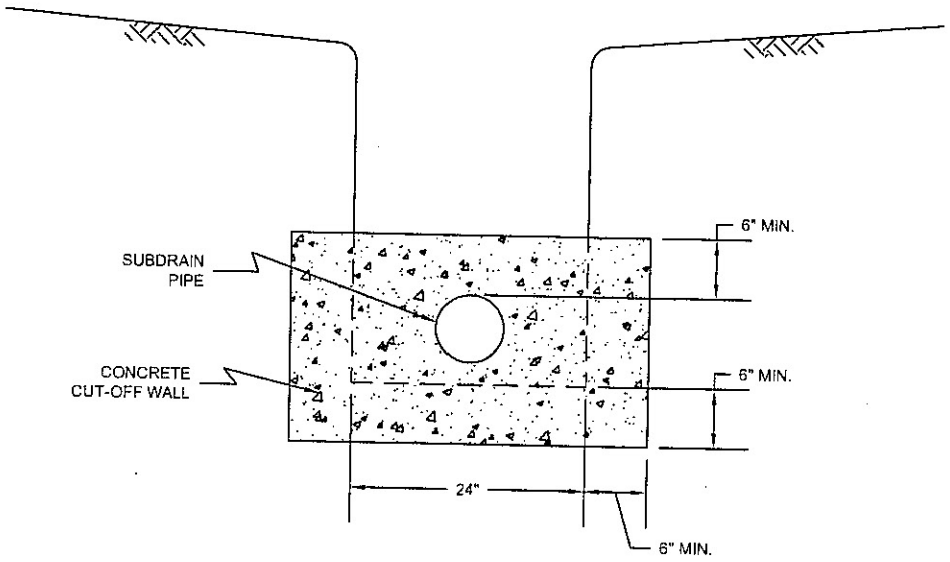
RG / RA		DSK/E0000

159 ACRE SITE
SAN DIEGO COUNTY, CALIFORNIA

DATE 02-28-2005	PROJECT NO. 07453 - 22 - 01	FIG. 5

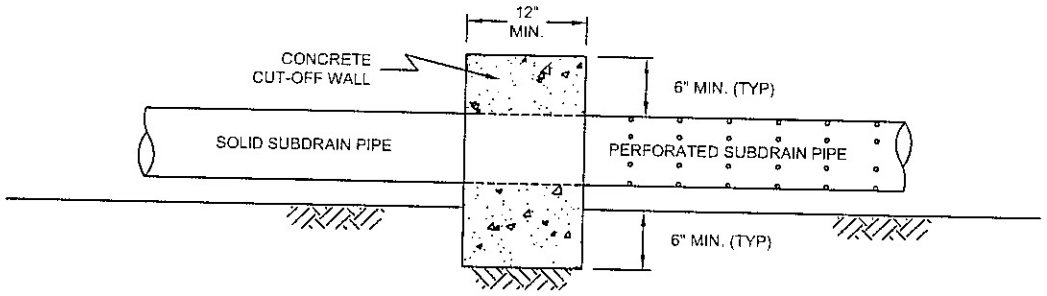
E:/GEOTECH/TYP/CYNDTAIL3/RA

FRONT VIEW



NO SCALE

SIDE VIEW



NO SCALE

TYPICAL SUBDRAIN CUT-OFF WALL DETAIL

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

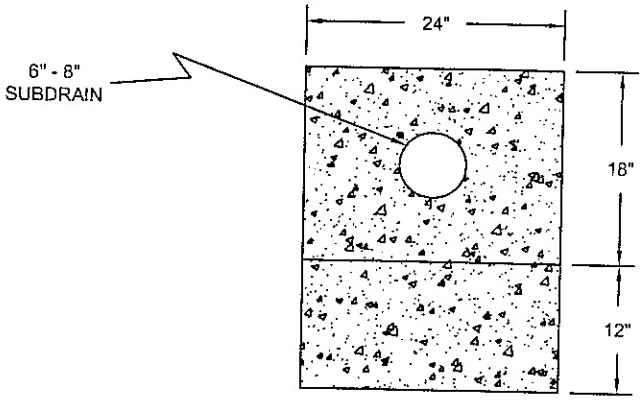
RG / RA		DSK/E0000

RSCOW.DWG/RA

159 ACRE SITE
SAN DIEGO COUNTY, CALIFORNIA

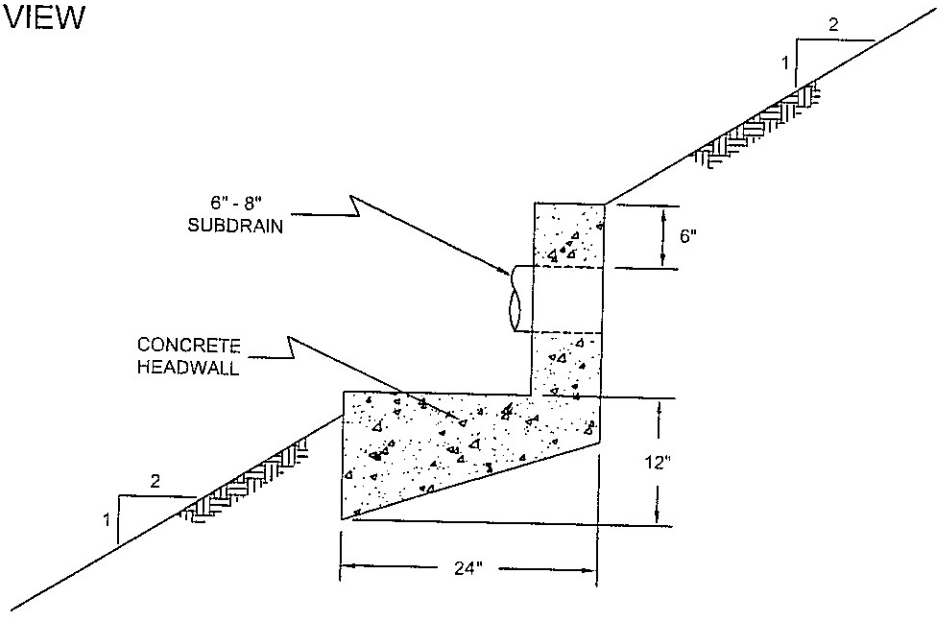
DATE 02-28-2005	PROJECT NO. 07453 - 22 - 01	FIG. 6

FRONT VIEW



NO SCALE

SIDE VIEW



NOTE: HEADWALL SHOULD OUTLET AT TOE OF FILL SLOPE
OR INTO CONTROLLED SURFACE DRAINAGE

NO SCALE

TYPICAL SUBDRAIN OUTLET HEADWALL DETAIL

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

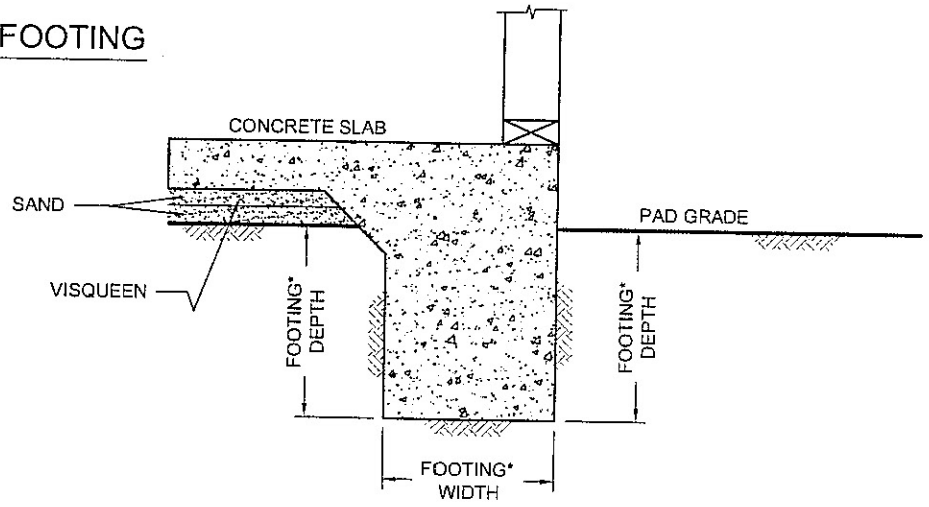
RG / RA		DSK/E0000

159 ACRE SITE
SAN DIEGO COUNTY, CALIFORNIA

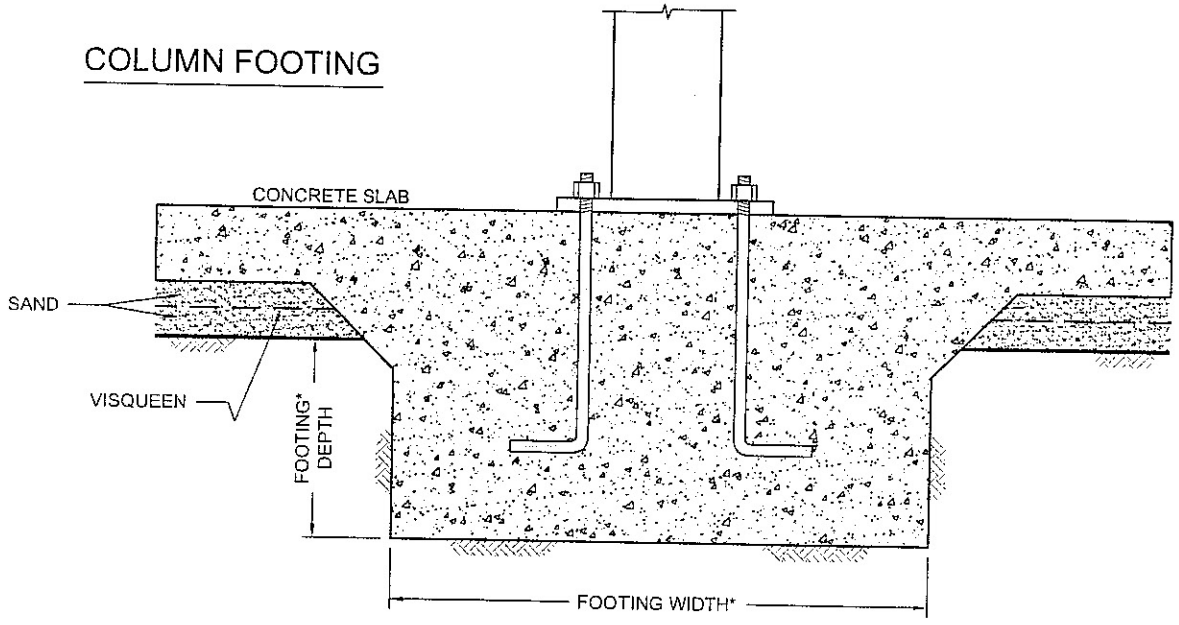
DATE 02-28-2005	PROJECT NO. 07453 - 22 - 01	FIG. 7

E:/GEOTECH/TYP/SOHD.DWG

WALL FOOTING



COLUMN FOOTING



*....SEE REPORT FOR FOUNDATION WITDH AND DEPTH RECOMMENDATION

NO SCALE

WALL / COLUMN FOOTING DIMENSION DETAIL

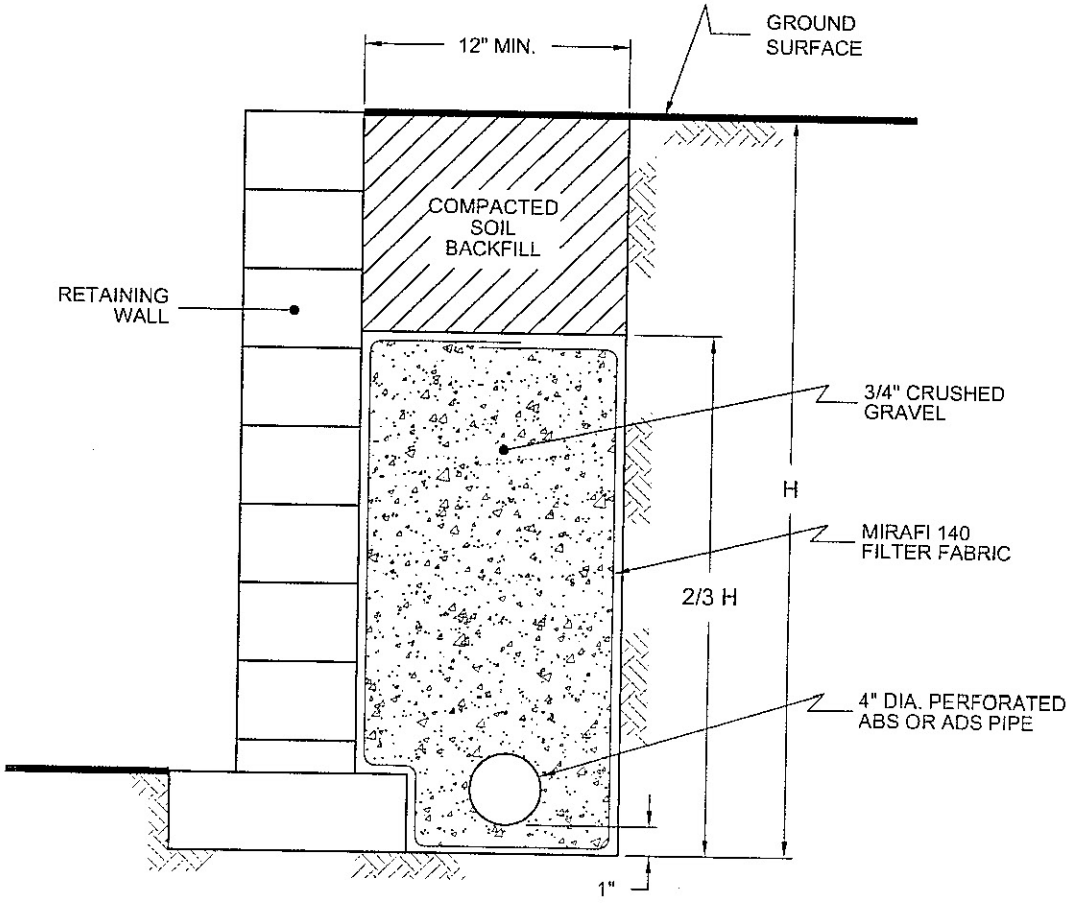
GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

RG / RA		DSK/E0000

159 ACRE SITE
SAN DIEGO COUNTY, CALIFORNIA

DATE 02-28-2005	PROJECT NO. 07453 - 22 - 01	FIG. 8

COLFOOT2.DWG/RA



NO SCALE

RETAINING WALL DRAINAGE DETAIL

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

RG/RA		DSK/E0000

159 ACRE SITE
SAN DIEGO COUNTY, CALIFORNIA

DATE 02-28-2005	PROJECT NO. 07453 - 22 - 01	FIG. 9

RETWALL3ra/DWG.

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	= 20 feet
SLOPE INCLINATION		2 : 1 (Horizontal : Vertical)
TOTAL UNIT WEIGHT OF SOIL	γ_t	= 117.5 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	= 34 degrees
APPARENT COHESION	C	= 340 pounds per square foot
NO SEEPAGE FORCES		

ANALYSIS :

$\gamma c\phi$	=	$\frac{\gamma H \tan\phi}{C}$	EQUATION (3-3), REFERENCE 1
FS	=	$\frac{NcfC}{\gamma H}$	EQUATION (3-2), REFERENCE 1
$\gamma c\phi$	=	4.7	CALCULATED USING EQ. (3-3)
Ncf	=	20	DETERMINED USING FIGURE 10, REFERENCE 2
FS	=	2.9	FACTOR OF SAFETY CALCULATED USING EQ. (3-2)

REFERENCES :

1.....Janbu, N., Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mechanics, Series No. 46, 1954

2.....Janbu, N., Discussion of J.M. Bell, Dimensionless Parameters for Homogeneous Earth Slopes, Journal of Soil Mechanics and Foundation Design, No. SM6, November 1967.

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

RG/ RA		DSK/GTYPD

FILL SLOPE STABILITY ANALYSIS

159 ACRE SITE
SAN DIEGO COUNTY, CALIFORNIA

DATE 02-28-2005	PROJECT NO. 07453 - 22 - 01	FIG. 10

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	= 20 feet
SLOPE INCLINATION		2 : 1 (Horizontal : Vertical)
TOTAL UNIT WEIGHT OF SOIL	γ_t	= 118.1 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	= 37 degrees
APPARENT COHESION	C	= 200 pounds per square foot
NO SEEPAGE FORCES		

ANALYSIS :

$\gamma_{c\phi}$	=	$\frac{\gamma H \tan\phi}{C}$	EQUATION (3-3), REFERENCE 1
FS	=	$\frac{NcfC}{\gamma H}$	EQUATION (3-2), REFERENCE 1
$\gamma_{c\phi}$	=	8.9	CALCULATED USING EQ. (3-3)
Ncf	=	30	DETERMINED USING FIGURE 10, REFERENCE 2
FS	=	2.5	FACTOR OF SAFETY CALCULATED USING EQ. (3-2)

REFERENCES :

1.....Janbu, N., Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mechanics, Series No. 46, 1954

2.....Janbu, N., Discussion of J.M. Bell, Dimensionless Parameters for Homogeneous Earth Slopes, Journal of Soil Mechanics and Foundation Design, No. SM6, November 1967.

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

RG/ RA		DSK/GTYPD

CUT SLOPE STABILITY ANALYSIS

159 ACRE SITE
SAN DIEGO COUNTY, CALIFORNIA

DATE 02-28-2005	PROJECT NO. 07453 - 22 - 01	FIG. 11

Drafting 2/ RLBEN/Templates/Details/Slope Stability

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	= Infinite
DEPTH OF SATURATION	Z	= 3 feet
SLOPE INCLINATION	2 : 1 (Horizontal : Vertical)	
SLOPE ANGLE	i	= 26.6 degrees
UNIT WEIGHT OF WATER	γ_w	= 62.4 pounds per cubic foot
TOTAL UNIT WEIGHT OF SOIL	γ_t	= 117.5 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	= 34 degrees
APPARENT COHESION	C	= 340 pounds per square foot

SLOPE SATURATED TO VERTICAL DEPTH Z BELOW SLOPE FACE

SEEPAGE FORCES PARALLEL TO SLOPE FACE

ANALYSIS :

$$FS = \frac{C + (\gamma_t - \gamma_w)\ Z\ cos^2\ i\ tan\ \phi}{\gamma_t\ Z\ sin\ i\ cos\ i} = 3.0$$

REFERENCES :

1.....Haefeli, R. *The Stability of Slopes Acted Upon by Parallel Seepage* , Proc. Second International Conference, SMFE, Rotterdam, 1948, 1, 57-62

2.....Skempton, A. W., and F.A. Delory, *Stability of Natural Slopes in London Clay* , Proc. Fourth International Conference, SMFE, London, 1957, 2, 378-81

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

RG / RA		DSK/GTYPD

SURFICIAL FILL SLOPE STABILITY ANALYSIS

159 ACRE SITE
SAN DIEGO COUNTY, CALIFORNIA

DATE 02-28-2005	PROJECT NO. 07453 - 22 - 01	FIG. 12

Drafting 2/RUBEN/Templates/Details/Surficial Slope

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	= Infinite
DEPTH OF SATURATION	Z	= 3 feet
SLOPE INCLINATION	2 : 1 (Horizontal : Vertical)	
SLOPE ANGLE	i	= 26.6 degrees
UNIT WEIGHT OF WATER	γ_w	= 62.4 pounds per cubic foot
TOTAL UNIT WEIGHT OF SOIL	γ_t	= 118.1 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	= 37 degrees
APPARENT COHESION	C	= 200 pounds per square foot

SLOPE SATURATED TO VERTICAL DEPTH Z BELOW SLOPE FACE

SEEPAGE FORCES PARALLEL TO SLOPE FACE

ANALYSIS :

$$FS = \frac{C + (\gamma_t - \gamma_w)\ Z\ cos^2\ i\ tan\ \phi}{\gamma_t\ Z\ sin\ i\ cos\ i} = 2.1$$

REFERENCES :

1.....Haefeli, R. *The Stability of Slopes Acted Upon by Parallel Seepage* , Proc. Second International Conference, SMFE, Rotterdam, 1948, 1, 57-62

2.....Skempton, A. W., and F.A. Delory, *Stability of Natural Slopes in London Clay* , Proc. Fourth International Conference, SMFE, London, 1957, 2, 378-81

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974
PHONE 858 558-6900 - FAX 858 558-6159

RG / RA		DSK/GTYPD

SURFICIAL CUT SLOPE STABILITY ANALYSIS

159 ACRE SITE
SAN DIEGO COUNTY, CALIFORNIA

DATE **02-28-2005**	PROJECT NO. 07453 - 22 - 01	FIG. 13

Drafting 2/RUBEN/Templates/Details/Surficial Slope

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

The field investigation was performed on January 17 and 18, 2005, and consisted of a site reconnaissance and excavating 22 exploratory trenches at the approximate locations shown on Figure 2. The trenches were excavated using a John Deere 760 backhoe. Bulk and chunk samples were collected from selected depths in the trenches. The exploratory excavations were extended to depths from 7½ to 18 feet below existing grades.

The soil conditions encountered in the trenches were visually examined, classified and logged in general accordance with the American Society for Testing and Materials (ASTM) Practice for Description and Identification of Soils (Visual-Manual Procedure D 2488). The logs of the exploratory trenches are presented on Figures A-1 through A-22. The logs depict the various soil types encountered and indicate the depths at which samples were obtained.

PROJECT NO. 07453-22-01

TRENCH T 1

ELEV. (MSL.) 535' DATE COMPLETED 01-17-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	T1-1			CL	**TOPSOIL** Soft, wet, brown CLAY; trace of sand			
	T1-2						81.7	34.2
2				ML	**OTAY FORMATION** Hard, moist, white to tan SILTSTONE, with some sand			
	T1-3						76.7	24.1
4	T1-4				Dense, moist, tan to brown, Silty, fine to medium SANDSTONE			
6								
	T1-5						98.2	19.6
8				SM				
10								
12								
14	T1-6			CL	Hard, moist, brown CLAYSTONE			
					Very dense, moist, brown, Clayey, fine SANDSTONE			
16				SC				
					TRENCH TERMINATED AT 17 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 1, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◥ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 2

ELEV. (MSL.) 531' DATE COMPLETED 01-17-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T2-1			CL	**TOPSOIL** Soft, wet, dark brown CLAY; trace of sand			
2	T2-2							
	T2-3				**OTAY FORMATION** Dense, moist, tan-brown, Silty, fine to medium SANDSTONE			
4								
	T2-4							
6								
8				SM				
10	T2-5							
	T2-6							
12					-Becomes very dense, moist, tan-brown, silty, fine to medium sandstone; moderately cemented			
14								
16	T2-7			CL	Hard, moist, brown CLAYSTONE			
				SM	Very dense, moist, light tan, Silty, fine to medium SANDSTONE			
18					TRENCH TERMINATED AT 18 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 2, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◣ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 3

ELEV. (MSL.) 538' DATE COMPLETED 01-17-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	T3-1			CL	**TOPSOIL** Soft, wet, brown CLAY			
2	T3-2							
4	T3-3			SM	**OTAY FORMATION** Dense, moist, pale tan, Silty, fine to medium SAND; (moderately weathered)			
6	T3-4							
8	T3-5				Dense, moist, tan, Silty, fine to medium SANDSTONE			
10	T3-6			SM				
12								
14								
16	T3-7							
					TRENCH TERMINATED AT 17 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 3, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◪ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 4

ELEV. (MSL.) 554' DATE COMPLETED 01-17-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	T4-1, T4-2			CL	**TOPSOIL** Soft, wet, brown CLAY; trace of sand		84.9	27.2
2	T4-3			SM	**OTAY FORMATION** Dense, moist, light tan, Silty, fine to medium SAND; krotovina (weathered)		82.4	8.7
4					Very dense, moist, tan to gray, Silty, fine to medium SANDSTONE			
6	T4-4, T4-5						111.9	5.5
8								
10	T4-6			SM				
12								
14								
16	T4-7			SC	Very dense, moist, tan-brown, Clayey, fine SANDSTONE			
					TRENCH TERMINATED AT 17 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 4, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◪ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 5

ELEV. (MSL.) 535' DATE COMPLETED 01-17-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T5-1			CL	**TOPSOIL** Soft, wet, brown CLAY; trace of sand			
2								
	T5-2			CL	**OTAY FORMATION** Hard, moist, brown, Sandy CLAYSTONE; trace gravel			
4								
	T5-3			GC	Very dense, moist, yellow-brown, CONGLOMERATE with clayey sand matrix, gravel and cobble			
	T5-4							
6								
8								
	T5-5			SM	Dense, moist, yellow-tan, Silty, very fine SANDSTONE			
10								
12								
14			▼		-Slight seepage -Becomes saturated at 15½ feet			
	T5-6							
16					TRENCH TERMINATED AT 17 FEET Groundwater encountered at 15½ feet			

07453-22-01.GPJ

Log of Trench T 5, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◹ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 6

ELEV. (MSL.) 558' DATE COMPLETED 01-17-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T6-1			CL	**TOPSOIL** Soft, wet, brown, Sandy CLAY			
2	T6-2			SM	**OTAY FORMATION** Dense, moist, light tan, Silty, fine SAND; krotovina (weathered)		83.0	16.6
4								
	T6-3				Very dense, moist, light tan, fine to medium SANDSTONE		86.5	8.3
6								
	T6-4							
8								
				SP				
10	T6-5						108.5	11.9
12								
14								
16	T6-6				TRENCH TERMINATED AT 16½ FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 6, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◣ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 7

ELEV. (MSL.) 525' DATE COMPLETED 01-17-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T7-1			CL	**TOPSOIL** Soft, wet, brown, Sandy CLAY			
2	T7-2				**OTAY FORMATION** Dense, moist, light tan, Silty, fine SANDSTONE			
4	T7-3							
	T7-4				-Becomes very dense, moist, light tan, silty, fine to medium sandstone			
6								
8								
				SM				
10	T7-5							
	T7-6							
12								
14								
16	T7-7							
					TRENCH TERMINATED AT 17 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 7, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◥ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 8

ELEV. (MSL.) 522' DATE COMPLETED 01-17-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T8-1			CL	**TOPSOIL** Soft, wet, brown CLAY			
2	T8-2							
					OTAY FORMATION Dense, moist, tan, Silty, fine to medium SANDSTONE			
4								
	T8-3			SM				
6								
	T8-4							
8								
10	T8-5				Very dense, moist, light gray, Silty, fine to medium SANDSTONE			
12								
14				SM				
16	T8-6				TRENCH TERMINATED AT 16 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 8, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◪ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 9

ELEV. (MSL.) 525' DATE COMPLETED 01-17-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
				CL	**TOPSOIL** Soft, wet, brown CLAY			
2	T9-1							
				SM	**OTAY FORMATION** Dense, moist, white to tan, Silty, fine SAND; krotovina (weathered)			
4	T9-2							
	T9-3				Very dense, moist, light tan, fine to medium SANDSTONE			
6								
8								
				SP				
10	T9-4							
12								
14								
16	T9-5							
					TRENCH TERMINATED AT 16½ FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 9, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◣ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 10

ELEV. (MSL.) 518' DATE COMPLETED 01-17-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0						
	T10-1	CL	**TOPSOIL** Soft, wet, brown CLAY			
2	T10-2	SM	**OTAY FORMATION** Dense, moist, light tan, Silty, fine SAND (weathered)		88.7	21.2
4			Very dense, moist, light tan, Silty, fine to medium SANDSTONE			
	T10-3				82.5	10.9
6		SM				
	T10-4					
8						
10	T10-5				105.8	18.6
	T10-6	CL	Hard, moist, tan-brown CLAYSTONE		99.6	21.2
12			Very dense, moist, tan-brown, Clayey, fine to medium SANDSTONE			
14		SC				
16	T10-7					
			TRENCH TERMINATED AT 16½ FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 10, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◪ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 11

ELEV. (MSL.) 522' DATE COMPLETED 01-17-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					MATERIAL DESCRIPTION			
	T11-1			CL	**TOPSOIL** Soft, wet, brown CLAY; trace of sand			
2								
	T11-2			SM	**OTAY FORMATION** Dense, moist, tan-brown, Silty, fine to medium SAND (weathered)			
	T11-3							
4					Very dense, moist, gray-tan, Silty, fine to medium SANDSTONE			
	T11-4							
6								
8								
				SM				
10	T11-5							
12								
14								
	T11-6							
16					TRENCH TERMINATED AT 16 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 11, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◪ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 12

ELEV. (MSL.) 518' DATE COMPLETED 01-17-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T12-1			CL	**TOPSOIL** Soft, wet, brown CLAY; trace of sand			
2	T12-2			SM	**OTAY FORMATION** Dense, moist, light tan, Silty, fine SAND; krotovina (weathered)			
4								
	T12-3				Very dense, moist, tan-brown, Silty, fine to medium SANDSTONE			
6	T12-4							
8								
				SM				
10	T12-5							
12								
14								
16								
	T12-6				TRENCH TERMINATED AT 17 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 12, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◥ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 13

ELEV. (MSL.) 509' DATE COMPLETED 01-18-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T13-1				**TOPSOIL** Soft, wet, brown CLAY; trace of sand			
2	T13-2			CL				
4					**TERRACE DEPOSITS** Very dense, moist, tan-brown, Silty, fine SANDSTONE			
	T13-3			SM				
6								
	T13-4				Dense, moist, tan-brown, fine to coarse SAND; cohesionless, caving, some gravel			
8								
10	T13-5			SP				
12								
14								
	T13-6				TRENCH TERMINATED AT 15 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 13, Page 1 of 1

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 14

ELEV. (MSL.) 509' DATE COMPLETED 01-18-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T14-1			CL	**TOPSOIL** Very soft, saturated, brown CLAY			
2	T14-2			CL	Soft, wet, brown CLAY; trace of sand			
4								
	T14-3			SM	**TERRACE DEPOSITS** Very dense, moist, light brown, Silty, fine to medium SANDSTONE			
6								
	T14-4							
8								
	T14-5							
10					TRENCH TERMINATED AT 10 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 14, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 15

ELEV. (MSL.) 512' DATE COMPLETED 01-18-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
					TOPSOIL Soft, wet, brown CLAY			
2	T15-1			CL				
	T15-2							
4					**TERRACE DEPOSITS** Dense, moist, brown, Clayey, fine to medium SANDSTONE			
	T15-3							
6								
8	T15-4			SC				
10	T15-5							
12								
14	T15-6							
					TRENCH TERMINATED AT 14½ FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 15, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◪ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 16

ELEV. (MSL.) 505' DATE COMPLETED 01-18-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	T16-1			CL	**ALLUVIUM** Soft, wet, brown, Sandy CLAY with gravel and cobble			
2								
	T16-2			GP	Dense, moist, COBBLE in brown, Clayey, fine to coarse SAND matrix			
4								
6					-Becomes tan-brown at 7 feet			
8								
10	T16-3			SC	**TERRACE DEPOSITS** Dense, moist, brown, Clayey, fine to coarse SANDSTONE			
12								
14				SP	Dense, moist, brown, fine to coarse SANDSTONE			
16	T16-4							
					TRENCH TERMINATED AT 17 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 16, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◥ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 17

ELEV. (MSL.) 512' DATE COMPLETED 01-18-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T17-1			CL	**TOPSOIL** Soft, wet, brown CLAY			
2	T17-2							
4					**TERRACE DEPOSITS** Dense, moist, tan-brown, Silty, fine to medium SANDSTONE			
	T17-3							
6								
8								
				SM				
10	T17-4							
12	T17-5							
14								
16								
	T17-6				TRENCH TERMINATED AT 17 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 17, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◪ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 18

ELEV. (MSL.) 499' DATE COMPLETED 01-18-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	T18-1			CL	**TOPSOIL** Soft, wet, brown CLAY; trace gravel			
2	T18-2			SC	**TERRACE DEPOSITS** Dense, moist, tan-brown, Clayey, fine to coarse SANDSTONE, some gravel		116.1	6.5
4	T18-3			SP	Very dense, moist, tan, fine to coarse SANDSTONE, some cobble		112.3	6.3
6	T18-4				-Becomes red-brown at 6½ feet			
8								
10	T18-5						126.5	6.6
12								
14								
16								
	T18-6				TRENCH TERMINATED AT 17½ FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 18, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 19

ELEV. (MSL.) 489' DATE COMPLETED 01-18-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T19-1			ML	**ALLUVIUM** Soft, wet, brown, Sandy SILT			
2	T19-2			GP	Dense, moist, brown, Sandy GRAVEL			
4				SC	Very dense, moist, brown, Clayey, fine to coarse SAND and cobble			
	T19-3							
6				SP	Very dense, moist, tan, fine to coarse SAND; trace cobble			
	T19-4							
8								
10	T19-5			SP	**TERRACE DEPOSITS** Very dense, moist, tan, fine to coarse SANDSTONE and cobble			
					Very dense, moist, orange-tan, fine to coarse SANDSTONE			
12				SP				
14								
16	T19-6				TRENCH TERMINATED AT 16 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 19, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◥ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 20

ELEV. (MSL.) 505' DATE COMPLETED 01-18-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T20-1			ML	**TOPSOIL** Soft, wet, brown SILT; trace of sand			
2	T20-2							
4					**TERRACE DEPOSITS** Hard, moist, brown, Sandy CLAYSTONE			
	T20-3						99.1	24.3
6	T20-4			CL				
8								
10								
	T20-5				Very dense, moist, red-brown, fine to coarse SANDSTONE		120.6	5.2
12								
14				SP				
	T20-6							
16					TRENCH TERMINATED AT 16 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 20, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◺ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 21

ELEV. (MSL.) 515' DATE COMPLETED 01-18-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
				ML	**TOPSOIL** Firm, moist, brown, Sandy SILT			
2	T21-1							
	T21-2			CL	**TERRACE DEPOSITS** Hard, moist, brown CLAYSTONE		103.9	10.8
4				GP	Very dense, moist, tan, Gravel and Cobble CONGLOMERATE with fine to coarse sand matrix			
	T21-3							
6								
				SP	Very dense, moist, tan-brown, fine to coarse SANDSTONE			
					TRENCH TERMINATED AT 7½ FEET (Due to refusal) No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 21, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◹ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 07453-22-01

TRENCH T 22

ELEV. (MSL.) 499' DATE COMPLETED 01-18-2005

EQUIPMENT JD 310

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T22-1			CL	**TOPSOIL** Soft, wet, brown, Sandy CLAY		106.2	15.6
2				ML	Moderately firm, wet, brown, Sandy SILT			
	T22-2				**TERRACE DEPOSITS** Hard, moist, brown CLAY with some cobbles		110.7	14.4
4	T22-3			CL				
	T22-4				Very dense, moist, red-brown, fine to coarse SANDSTONE; trace gravel and cobble		101.0	10.6
6								
8	T22-5							
10	T22-6			SP			121.0	4.3
12								
14								
16								
	T22-7				TRENCH TERMINATED AT 17 FEET No groundwater encountered			

07453-22-01.GPJ

Log of Trench T 22, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◹ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

APPENDIX B

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in general accordance with the test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected relatively undisturbed chunk samples were tested for their in-place dry density and moisture content. Selected bulk samples were tested for their maximum dry density and optimum moisture content, potential of hydrogen, minimum electrical resistivity, water-soluble sulfate, R-Value, and expansion characteristics. Portions of the bulk samples were remolded to selected densities and subjected to drained direct shear testing.

The results of our laboratory tests are presented in tabular form hereinafter. The in-place dry density and moisture characteristics are presented on the logs of exploratory trenches.

TABLE B-I
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS
ASTM D 3080

Sample No.	Dry Density (pcf)	Moisture Content (%)	Unit Cohesion (psf)	Angle of Shear Resistance (degrees)
T4-4*	111.7	5.7	200	37
T4-5**	103.5	13.5	340	34

* Soil sample remolded to in situ density and moisture content.
** Soil sample remolded to approximately 90 percent of the maximum dry density at near-optimum moisture content.

TABLE B-II
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS
ASTM D 1557

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
T4-5	Gray brown, silty, fine to medium SAND	114.6	13.9

TABLE B-III
SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS
ASTM D 4829

Sample No.	Moisture Content		Dry Density (pcf)	Expansion Index
	Before Test (%)	After Test (%)		
T1-1	20.7	47.8	80.9	121
T5-3	11.5	24.5	103.5	30
T8-1	15.7	29.8	95.0	80
T20-4	20.7	41.3	81.7	65

TABLE B-IV
SUMMARY OF LABORATORY MINIMUM RESISTIVITY, POTENTIAL OF HYDROGEN (pH), AND WATER-SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NOS. 417 AND 643

Sample No.	Minimum Resistivity (ohm-cm)	pH	Water-Soluble Sulfate Content (%)
T6-4	365	7.6	0.108

TABLE B-V
SUMMARY OF LABORATORY R-VALUE TEST RESULTS
ASTM D 2844-99

Sample No.	R-Value
T1-4	26
T15-2	<5

APPENDIX C

APPENDIX C

RECOMMENDED GRADING SPECIFICATIONS

FOR

159-ACRE PROPERTY
ALTA ROAD AND AIRWAY ROAD
SAN DIEGO COUNTY, CALIFORNIA

PROJECT NO. 07453-22-01

RECOMMENDED GRADING SPECIFICATIONS

1. GENERAL

1.1. These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon Incorporated. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.

1.2. Prior to the commencement of grading, a geotechnical consultant (Consultant) shall be employed for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. It will be necessary that the Consultant provide adequate testing and observation services so that he may determine that, in his opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep him apprised of work schedules and changes so that personnel may be scheduled accordingly.

1.3. It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, adverse weather, and so forth, result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that construction be stopped until the unacceptable conditions are corrected.

2. DEFINITIONS

2.1. **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.

2.2. **Contractor** shall refer to the Contractor performing the site grading work.

2.3. **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.

2.4. **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

2.5. **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.

2.6. **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.

2.7. **Geotechnical Report** shall refer to a soil report (including all addenda) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3. MATERIALS

3.1. Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills, *soil-rock* fills or *rock* fills, as defined below.

3.1.1. **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than 3/4 inch in size.

3.1.2. **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of soil fill to allow for proper compaction of soil fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize rock** is defined as material greater than 12 inches.

3.1.3. **Rock fills** are defined as fills containing no rocks or hard lumps larger than 3 feet in maximum dimension and containing little or no fines. Fines are defined as material smaller than 3/4 inch in maximum dimension. The quantity of fines shall be less than approximately 20 percent of the rock fill quantity.

3.2. Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.

3.3. Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9 and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

3.4. The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant. *Rock* fill may extend to the slope face, provided that the slope is not steeper than 2:1 (horizontal:vertical) and a soil layer no thicker than 12 inches is track-walked onto the face for landscaping purposes. This procedure may be utilized, provided it is acceptable to the governing agency, Owner and Consultant.

3.5. Representative samples of soil materials to be used for fill shall be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

3.6. During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition

4. CLEARING AND PREPARING AREAS TO BE FILLED

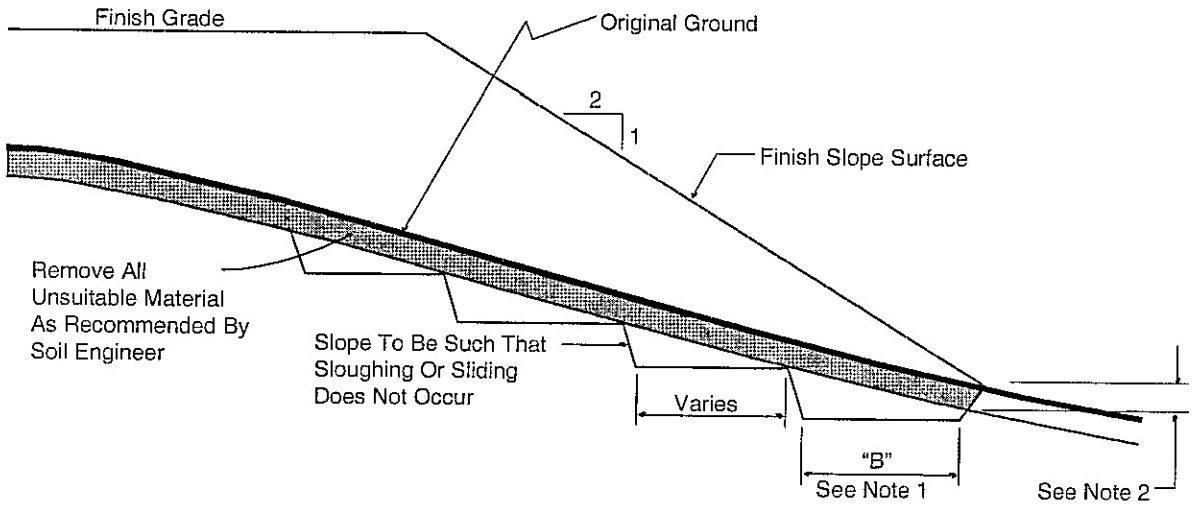
4.1. Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1-1/2 inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.

4.2. Any asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility. Concrete fragments which are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 or 6.3 of this document.

4.3. After clearing and grubbing of organic matter or other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction shall be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

4.4. Where the slope ratio of the original ground is steeper than 6:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



No Scale

DETAIL NOTES:

(1) Key width "B" should be a minimum of 10 feet wide, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.

(2) The outside of the bottom key should be below the topsoil or unsuitable surficial material and at least 2 feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Consultant.

4.5. After areas to receive fill have been cleared, plowed or scarified, the surface should be disced or bladed by the Contractor until it is uniform and free from large clods. The area should then be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6.0 of these specifications.

5. COMPACTION EQUIPMENT

5.1. Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.

5.2. Compaction of *rock* fills shall be performed in accordance with Section 6.3.

6. PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

6.1. *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:

6.1.1. *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.

6.1.2. In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D1557-00.

6.1.3. When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.

6.1.4. When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.

6.1.5. After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D1557-00. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum relative compaction has been achieved throughout the entire fill.

6.1.6. Soils having an Expansion Index of greater than 50 may be used in fills if placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.

6.1.7. Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.

6.1.8. As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.

6.2. *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:

6.2.1. Rocks larger than 12 inches but less than 4 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.

6.2.2. Rocks or rock fragments up to 4 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 10 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved by the Consultant prior to placement.

6.2.3. For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.

6.2.4. For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 5 feet wide and 4 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

6.2.5. Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.

6.2.6. All rock placement, fill placement and flooding of approved granular soil in the windrows must be continuously observed by the Consultant or his representative.

6.3. *Rock* fills, as defined in Section 3.1.3., shall be placed by the Contractor in accordance with the following recommendations:

6.3.1. The base of the *rock* fill shall be placed on a sloping surface (minimum slope of 2 percent, maximum slope of 5 percent). The surface shall slope toward suitable subdrainage outlet facilities. The *rock* fills shall be provided with subdrains during construction so that a hydrostatic pressure buildup does not develop. The subdrains shall be permanently connected to controlled drainage facilities to control post--construction infiltration of water.

6.3.2. *Rock* fills shall be placed in lifts not exceeding 3 feet. Placement shall be by rock trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the *rock* fill shall be by dozer to facilitate *seating* of the rock. The *rock* fill shall be watered heavily during placement. Watering shall consist of water trucks traversing in front of the current rock lift face and spraying water continuously during rock placement. Compaction equipment with compactive energy comparable to or greater than that of a 20-ton steel vibratory roller or other compaction equipment providing suitable energy to achieve the required compaction or deflection as recommended in Paragraph 6.3.3 shall be

utilized. The number of passes to be made will be determined as described in Paragraph 6.3.3. Once a *rock* fill lift has been covered with *soil* fill, no additional *rock* fill lifts will be permitted over the *soil* fill.

6.3.3. Plate bearing tests, in accordance with ASTM D1196-93, may be performed in both the compacted *soil* fill and in the *rock* fill to aid in determining the number of passes of the compaction equipment to be performed. If performed, a minimum of three plate bearing tests shall be performed in the properly compacted *soil* fill (minimum relative compaction of 90 percent). Plate bearing tests shall then be performed on areas of *rock* fill having two passes, four passes and six passes of the compaction equipment, respectively. The number of passes required for the *rock* fill shall be determined by comparing the results of the plate bearing tests for the *soil* fill and the *rock* fill and by evaluating the deflection variation with number of passes. The required number of passes of the compaction equipment will be performed as necessary until the plate bearing deflections are equal to or less than that determined for the properly compacted *soil* fill. In no case will the required number of passes be less than two.

6.3.4. A representative of the Consultant shall be present during *rock* fill operations to verify that the minimum number of "passes" have been obtained, that water is being properly applied and that specified procedures are being followed. The actual number of plate bearing tests will be determined by the Consultant during grading. In general, at least one test should be performed for each approximately 5,000 to 10,000 cubic yards of *rock* fill placed.

6.3.5. Test pits shall be excavated by the Contractor so that the Consultant can state that, in his opinion, sufficient water is present and that voids between large rocks are properly filled with smaller rock material. In-place density testing will not be required in the *rock* fills.

6.3.6. To reduce the potential for "piping" of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant prior to commencing grading. The gradation of the graded filter material will be determined at the time the *rock* fill is being excavated. Materials typical of the *rock* fill should be submitted to the Consultant in a timely manner, to allow design of the graded filter prior to the commencement of *rock* fill placement.

6.3.7. All *rock* fill placement shall be continuously observed during placement by representatives of the Consultant.

7. OBSERVATION AND TESTING

7.1. The Consultant shall be the Owners representative to observe and perform tests during clearing, grubbing, and filling and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill shall be placed without at least one field density test being performed within that interval. In addition, a minimum of one field density test shall be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.

7.2. The Consultant shall perform random field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion as to whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.

7.3. During placement of *rock* fill, the Consultant shall verify that the minimum number of passes have been obtained per the criteria discussed in Section 6.3.3. The Consultant shall request the excavation of observation pits and may perform plate bearing tests on the placed *rock* fills. The observation pits will be excavated to provide a basis for expressing an opinion as to whether the *rock* fill is properly seated and sufficient moisture has been applied to the material. If performed, plate bearing tests will be performed randomly on the surface of the most-recently placed lift. Plate bearing tests will be performed to provide a basis for expressing an opinion as to whether the *rock* fill is adequately seated. The maximum deflection in the *rock* fill determined in Section 6.3.3 shall be less than the maximum deflection of the properly compacted *soil* fill. When any of the above criteria indicate that a layer of *rock* fill or any portion thereof is below that specified, the affected layer or area shall be reworked until the *rock* fill has been adequately seated and sufficient moisture applied.

7.4. A settlement monitoring program designed by the Consultant may be conducted in areas of *rock* fill placement. The specific design of the monitoring program shall be as recommended in the Conclusions and Recommendations section of the project Geotechnical Report or in the final report of testing and observation services performed during grading.

7.5. The Consultant shall observe the placement of subdrains, to verify that the drainage devices have been placed and constructed in substantial conformance with project specifications.

7.6. Testing procedures shall conform to the following Standards as appropriate:

7.6.1. Soil and Soil-Rock Fills:

7.6.1.1. Field Density Test, ASTM D1556-00, *Density of Soil In-Place By the Sand-Cone Method.*

7.6.1.2. Field Density Test, Nuclear Method, ASTM D2922-96, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).*

7.6.1.3. Laboratory Compaction Test, ASTM D1557-00, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop.*

7.6.1.4. Expansion Index Test, ASTM D4829-95, *Expansion Index Test.*

7.6.2. Rock Fills

7.6.2.1. Field Plate Bearing Test, ASTM D1196-93 (Reapproved 1997) *Standard Method for Nonreparative Static Plate Load Tests of Soils and Flexible Pavement Components, For Use in Evaluation and Design of Airport and Highway Pavements.*

8. PROTECTION OF WORK

8.1. During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.

8.2. After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

9. CERTIFICATIONS AND FINAL REPORTS

9.1. Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.

9.2. The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.